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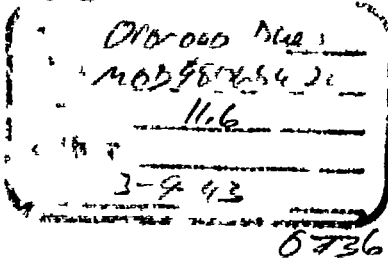
BROWN & ROOT, INC

ENGINEERING CONSTRUCTION

P O BOX No 3

HOUSTON TEXAS

TELEPHONES
L. D 119
CAPITOL 2381



2362 Massachusetts Ave N W

Washington, D C

March 9, 1943

Mr George R Brown

Brown & Root, Inc

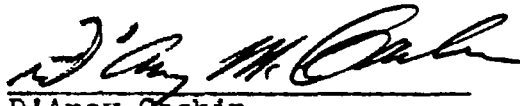
P O Box No 3

Houston, Texas

Dear Mr Brown

Enclosed herewith, please find a copy of the
Bureau of Mines Report on the Webb City Area, which
I thought might be of interest to you

Sincerely yours,


D'Arcy Cashin

enc

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(Subject to Correction and Revision)

PRELIMINARY WAR MINERALS REPORT

Report of the Bureau of Mines to Secretary of Interior Harold L. Ickes

- Second Report -

ORONOGO-WEBB CITY-DUENWEG ZINC-LEAD DISTRICT

Jasper County, Missouri

- Zinc and Lead -

Sources of information (exclusive of those mentioned in report)

Underground surveys from former operating companies

Drill logs and cost data from former mining companies

Report on Webb City district, by Victor Rakowsky

Report on Webb City district, by W. M. Stewart

Sources of information on file at office of District No. 3, Central
Region, Bureau of Mines

Logs and sampling records of 1000 drill holes

Map of district, scale 1 inch to 1600 feet

Map of district, scale 1 inch to 1200 feet

Complete set of maps showing mine workings, shafts, drill
holes and pumping stations, scale 1 inch to 200 feet

Production data

Cross sections.

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Preliminary Issue
For Temporary Use Only
Subject to Correction

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January, 1943

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PRELIMINARY WAR MINERALS REPORT ^{1/}

Report of the Bureau of Mines to Secretary of Interior Harold L. Ickes

- Second Report -

ORONOGO-WEBB CITY-DUENWEG ZINC-LEAD DISTRICT

Jasper County, Missouri

- Zinc and Lead -

SUMMARY

The Oronogo-Webb-City-Duenweg district is the most important one in regard to available reserves in the southwestern Missouri zinc and lead fields. Mines in the district were first operated over 70 years ago, and prior to 1932 had produced approximately 1,477,000 tons of zinc and 488,000 tons of lead from 84,000,000 tons of ore. Although most of the district has been idle since 1919, due mainly to the working of the richer deposits in Oklahoma and Kansas, commercial operations based on the present premium prices for zinc and lead are again feasible.

Estimates of available ore reserves by engineers of the Bureau of Mines, in collaboration with the William Stewart Engineering Company of Joplin, show 18,863,530 tons of ore from which, with modern mills, a recovery of 1 469 percent metallic zinc and 0 276 percent metallic lead in zinc and lead concentrates may be anticipated. In addition, the geological conditions are favorable for the development by churn drilling of 16,000,000 tons of ore of a similar or better grade.

Drainage of the district, which has an area of 14 square miles, rehabilitation and operation of the mines, and the construction of a central mill with a capacity of 10,000 tons daily is proposed by Brown and Root, Inc. of Houston, Texas. This company is requesting financial assistance through the Reconstruction Finance Corporation for the initial capital requirements, estimated at \$2,387,953.

^{1/} This preliminary war minerals report has been prepared for the engineers and consultants of the Bureau of Mines for their technical review and criticism, and to keep them informed of the progress of the Bureau of Mines war minerals program. It is not to be made available to others, as the data are subject to correction and revision. The final report, when issued, will be distributed on a limited basis to officials of the Federal war agencies, the owners or operators of the properties described therein, and to certain others with specific concern in the production of minerals vital to the prosecution of the war.

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At the proposed capacity the anticipated yearly production of metals, after allowing for smelter losses, are 46,311 tons of zinc and 9,484 tons of lead, starting early in 1944. The estimated cost of exploitation, exclusive of royalty, is \$1 93 a ton, which is equivalent to \$68 90 a ton of concentrate.

The Bureau of Mines believes that under the present conditions with respect to zinc, and the situation in the Tri-State district with respect to available reserves, consideration should be given to expediting the exploitation of the mines by financial assistance through regular Federal agencies.

Coincident with the drainage and rehabilitation of the mines, the Bureau of Mines plans to explore by churn drilling certain areas favorable for the development of higher grade ores which could be exploited during the present emergency.

INTRODUCTION

The Webb City (Oronogo-Webb City-Duenweg) district is a mining area approximately 8 miles long and 2 miles wide that extends in a northwest-southeast direction from Oronogo to Duenweg in the southern part of Jasper County, Missouri (See Figure 1). The Oronogo Mutual Mining Company is exploiting the Oronogo Circle deposit in the northern end of the district, and the Federal Mining & Smelting Company is building a mill to treat ores from its property near Duenweg. Therefore, these areas are not considered in this report.

The re-opening of the sheet ground deposits in the central part of the district as a source of new zinc to compensate for the decreasing production from the Oklahoma mines has been under consideration by a number of operators and Federal agencies since early 1942. An initial report on the district was made by an engineer ^{2/} of the Bureau of Mines in July, 1942. It was then proposed to start operations at a rate of 4,500 tons a day.

In September, 1942 Brown and Root, Inc. of Houston, Texas, because interested in the field, and the Webb City Drainage District, a Missouri corporation, undertook to obtain leases on all the acreage desired by the Brown and Root firm. The William M. Stewart Engineering Company was retained to investigate the proposal and make a report in support of a request for a Federal loan.

Since the Bureau of Mines was also conducting investigations in the same area, an engineer ^{2/} was assigned in October, 1942 to collaborate with the William M. Stewart Engineering Company. The work consisted of compiling all the available data, the analysis of all drilling, the estimated reserves, and the estimated capital requirements and operating costs.

^{2/} McMillan, W. D., District Engineer

^{2/} Ruhl, Otto, Mining Engineer

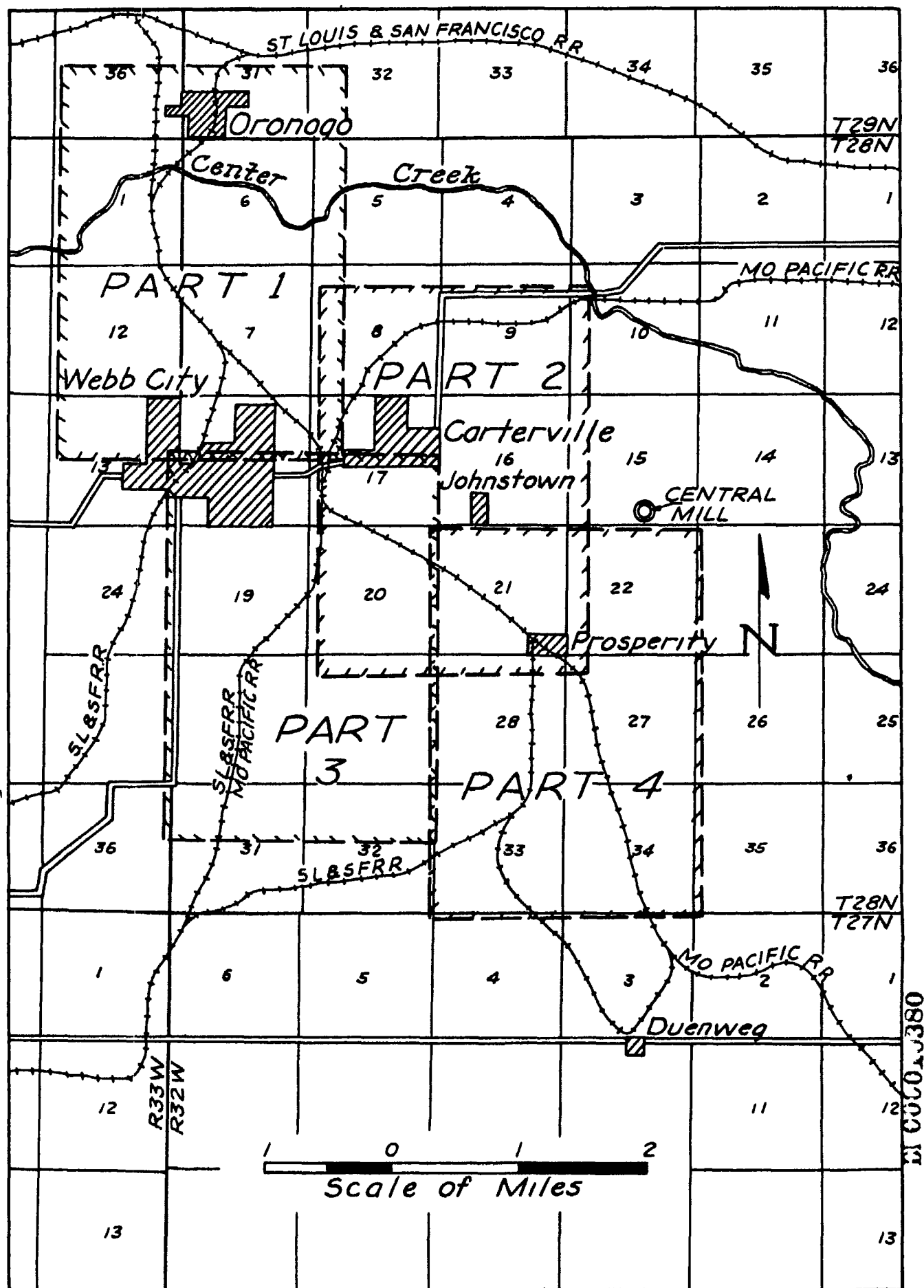


FIG-1-ORONOGO-WEBB CITY-DUENWEG DISTRICT

Numerous engineers and geologists in the district have contributed data from their files and freely cooperated in giving their time and experience to aid in the compilation of these data. Former mine operators and superintendents have also supplied maps, drill hole logs and given cost records and other information on mines which they operated.

In the limits of the area approximately 7,826 acres are potentially productive. The lands are owned in fee by many individuals or corporations. Brown and Root, Inc. of Houston, Texas holds leases on 5,540 acres at a royalty of 5 percent on the gross output. Leases covering 740 acres are being prepared and negotiations are in progress for 370 acres more at the same rate of royalty. D. M. Cashin, Engineer, represents Brown and Root, Inc. at Joplin and Webb City, Missouri. The 5,540-acre group of leases represents 71 percent of the mineralized zone and when the additional 1,110 acres are obtained 85 percent of the district will be under lease to Brown and Root, Inc.

Production records of the Tri-State district usually refer to grade of concentrate, which is the practice followed in this field. To conform with this, all estimates on reserves and production in the body of this report are in zinc and lead concentrates which have average metallic contents of 60 percent zinc and 79 percent lead, respectively.

PHYSICAL FEATURES

The district is in open, gently rolling country at a mean elevation of 955 feet, with a maximum relief of 150 feet. The lowest point is on Center Creek in the northern part of the district, which flows west and joins Spring River about 7 miles west of Webb City. The drainage of the greater part of the area is to the north.

The district has paved highways throughout, and is served by both the Missouri Pacific and St. Louis-San Francisco railroads.

LABOR AND LIVING CONDITIONS

Skilled labor is not plentiful although the situation is better than in the Miami-Picher district of Oklahoma. The current daily wage scale is \$5.50 to \$6.00 for common labor and \$6.50 to \$7.00 for miners and skilled labor.

Accommodations for workmen are available at reasonable rates in the nearby towns of Joplin, Webb City, Cartersville and Oronogo.

HISTORY

The Webb City mining district is a distinct mineralized area and has been well developed by actual mining operations throughout the length and breadth of the zone of mineralization. For a number of years the area was responsible for the major portion of the Tri-State zinc and lead production. It lost its position of leading producer when the richer orebodies were discovered in the Picher, Oklahoma field, and by 1920 the camp was practically idle and the mines were allowed to fill with water. The camp was never mined out but its operators moved their activities to the Picher field where greater returns were possible.

The history of its production covers a period of more than 70 years. Its early production was from shallow levels which were later followed by the exploitation of large, rich deposits of zinc and lead ores in the solution channels along the unconformity between the Mississippian and Pennsylvanian rocks. At a later period the development was extended to the Grand Falls chert member of the Boone formation, known as the Sheet-Ground Level (see Figure 6). It is from this level that the Webb City district earned its position as a leading producer in the Tri-State field prior to 1920. This was the beginning of the construction of larger concentrating plants, which increased in capacity from 100 tons to 600 tons daily, and more attention was given to mill efficiency, which prior to that time had been only from 50 to 55 percent. By the end of 1919 this efficiency had reached an estimated 60 to 65 percent.

Production from this district prior to 1932 was approximately 1,477,000 tons of zinc metal and 488,000 tons of lead metal in concentrates from 84,000,000 tons of ore. In the 10-year period from 1909 to 1919 the sheet-ground mines of southwestern Missouri produced 1,092,630 tons of zinc concentrate and 224,443 tons of lead concentrate from 53,933,640 tons of ore, which represents a combined concentrate recovery of 24.4 percent.

The rate of production was greatest in 1915-1917, during which period 416,649 tons of sphalerite concentrate and 77,894 tons of galena concentrate were produced from a reported 22,673,950 tons of ore. Unit recoveries were 18.35 percent zinc concentrate and 0.344 percent lead concentrate, or a combined unit concentrate of 2.18 percent. The details on production during this period are given in Table 1.

Table 1 Sheet Ground Production of Lead and Zinc-1900-1919.

Year	Ore Short Tons	PRODUCTION						Combined Recovery of Concen- trates Percent
		LEAD			ZINC			
		Concen- trate Short Tons	Analys- sis Per- cent	Lead Concen- trate Recovered Percent	Concen- trate Short Tons	Analys- sis Per- cent	Zinc Concen- trate Recovered Percent	
1909	4,994,120	24,970	80.0	0.50	108,858	59.5	2.2	2.70
1910	5,779,190	23,300	79.0	0.40	127,142	59.3	2.2	2.60
1911	4,944,910	24,725	79.0	0.50	103,843	58.6	2.1	2.60
1912	5,465,100	25,056	79.6	0.46	117,955	58.6	2.16	2.62
1913	4,303,900	20,389	79.0	0.47	92,912	58.3	2.16	2.63
1914	3,594,170	15,568	79.3	0.44	80,228	58.4	2.23	2.67
1915	6,501,000	21,658	76.4	0.34	124,067	59.1	1.19	2.25
1916	8,484,700	28,077	76.5	0.33	157,804	59.2	1.86	2.19
1917	7,688,250	28,159	75.9	0.36	134,778	58.6	1.75	2.11
1918	1,903,800	9,773	77.4	0.51	39,768	57.7	2.10	2.60
1919	274,500	2,768	81.1	1.01	5,275	54.9	1.92	2.83

Totals
53,933,640 224,443 78.6 0.42 1,092,630 58.4 2.02 2.44

Totals
1915)
1916) 22,673,950 77,894 0.34 416,649 1.84 2.18
1917)

Estimated Mill Efficiency - 60 to 65 percent

ORE DEPOSITS

The ore deposits in the Tri-State district are found principally in the Boone formation of lower Mississippian age, although in the area under consideration commercial ores have been found from the surface of the ground to a depth of 250 feet

Three types of ore deposits occur in the Oronogo-Webb Cit - Duenweg district.

1 Circle Deposits or irregular "runs" occurring at or just below the unconformity between the Pennsylvanian and Mississippian rocks, in sink holes or along solution channels in the limestones. These deposits are the richer ones of the field and are found from the surface to a depth of 180 feet. The Oronogo Circle and Center Creek groups typify this class of deposits.

2 Sheet Ground Deposits underlying the above type in flat lying or slightly rolling beds of chert are the type principally considered in this report. The minerals sphalerite and galena occur as "sheets" interbedded with chert, somewhat broken or brecciated, with some of the minerals in the broken interstices of the chert. The degree of mineralization in this type of orebody is somewhat related to the overlying irregular runs and fracture zones.

3. The third type is below the sheet ground in the Reeds Spring formation and consist of simple and compound "runs," between fairly well defined walls. These ore deposits follow well defined fractures and have been mined recently in the north end of the area. The record indicates this type to be richer than the "sheet ground" but not as extensive.

The first type was mined in the early history of the camp and was followed by the extensive development of the "sheet ground" and more recently came the discovery of the third type and its subsequent testing in the north end of the area. The records of mining these different types of orebodies indicate faces of 6 to 150 feet and concentrate recoveries as high as 30 percent on the first type, faces of 6 to 20 feet and concentrate recoveries of 2 to 6 percent on the second type and faces of 7 to 11 feet with concentrate recoveries of 5 to 11 percent on the third type. Present indications are that the first type is now entirely worked out unless exploration develops new areas that the second type has extensive reserves developed from one end of the district to the other, while the third type offers the possibility of important extensions through exploration in fractured areas of the Reed Springs formation.

THE ORE

Sphalerite and galena are the commercial minerals, associated with small amounts of marcasite and larger amounts of jasperoid, calcite and dolomite. In general the ore material is readily amenable to concentration by gravity and flotation methods, with a combined extraction in modern mills of 85 percent in zinc and lead concentrates containing 60 percent zinc and 80 percent lead respectively.

MINE DEVELOPMENT

In this district there have been 146 mining companies operating on the sheet ground ore horizon. The mine workings resulting from this activity cover approximately 1,307 acres, which is 17 percent of the total possible mineralized zone in the district. The working faces in the district have a total length of 38.4 miles.

All the mines are opened by vertical or incline shafts. Depending upon the surface topography, the depth of the mine levels ranges from 150 to 240 feet. The sheet ground orebodies are flat lying beds from 6 to 30 feet thick but averaging close to 14 feet over the entire area. (See Cross-Section, Figure 6) Roofs are supported by pillars, usually approximately 10 percent of the area mined.

Where the height of the roof is not over 9 feet mining is carried on by breast drilling the faces of the drifts, spacing pillars to protect the roof in the leanest ore or dead ground wherever possible. If the height of face exceeds nine feet, an eight foot face is used as a breast and the remainder stoped by underhand methods.

ORE RESERVES

TONNAGES

All the underground mine maps of the district were compiled on plates with a scale of 200 feet to the inch and all available drill hole records were placed on these maps, which also show the location of all shafts. The elevations of shaft collars and bottoms, and of the floors and roofs of stopes were reduced to common sea level datum.

From these data the available tonnages in the sheet ground were calculated, all blocks of ore being arbitrarily reduced 10 percent for pillars and a variable percentage for a safety factor, the latter depending on the conditions in each block

The total estimated tonnage now available for exploitation is 18,863,530 in 38 blocks with an average thickness of 12.8 feet, as shown in Table II. (See Figures 2, 3, 4, and 5 for location of blocks.)

Table 2 Blocks of Developed Ore

Block number	Drainage area No	Net area, square feet	Estimated thickness, feet	Ore - short tons, factor, 12 5 cu ft /ton	For location see Figure
I	I	279,650	14	312,480	2
II	I	405,280	14	453,880	2
III	I	936,000	14	1,048,000	2
IV	I	451,350	14	505,000	2
IV-A	I	116,960	14	131,000	2
V	I	1,170,000	14	1,250,000	2
V-A	I	103,000	14	115,000	2
VI	I	411,000	14	460,320	2
VII	I	1,000,000	13	1,040,000	2
VIII	I	610,000	13	634,000	2
IX	I	552,750	13	595,000	2
X	II	326,200	13	339,000	2
X-A	II	62,390	13	64,900	3
XI	II	77,040	13	80,000	3
XII	II	408,750	13	425,000	2 and 3
XIII	III	399,720	13	416,000	4
XIV	III	59,520	13	62,000	3
XV	III	128,160	13	133,000	4
XVI	III	799,200	13	831,170	4
XVII	III	150,750	13	156,780	4
XVIII	IV	2,016,000	13	2,096,000	4
XIX	IV-A	540,000	11	475,000	4
XX	V	570,000	12	544,000	3
XXI	V	148,000	12	142,000	3
XXII	V	748,500	12	718,000	3
XXIII	V	339,200	12	326,000	3
XXIV	V	329,600	12	316,000	3
XXV	V	490,000	12	470,000	3
XXVI	V	121,000	12	116,000	3
XXVII	V	721,000	12	690,000	3 and 5
XXVIII	V	273,000	12	262,000	3 and 5
XXIX	V	312,000	12	300,000	3 and 5
XXX	V	276,000	12	265,000	5
XXXI	V	487,000	12	468,000	5
XXXII	VI	720,000	12	691,000	5
XXXIII	VI	1,568,000	12	1,500,000	5
XXXIV	VI	113,000	12	108,000	5
XXXV	VI	338,000	12	324,000	5
Total-average		18,558,020	12 8	18,863,530	

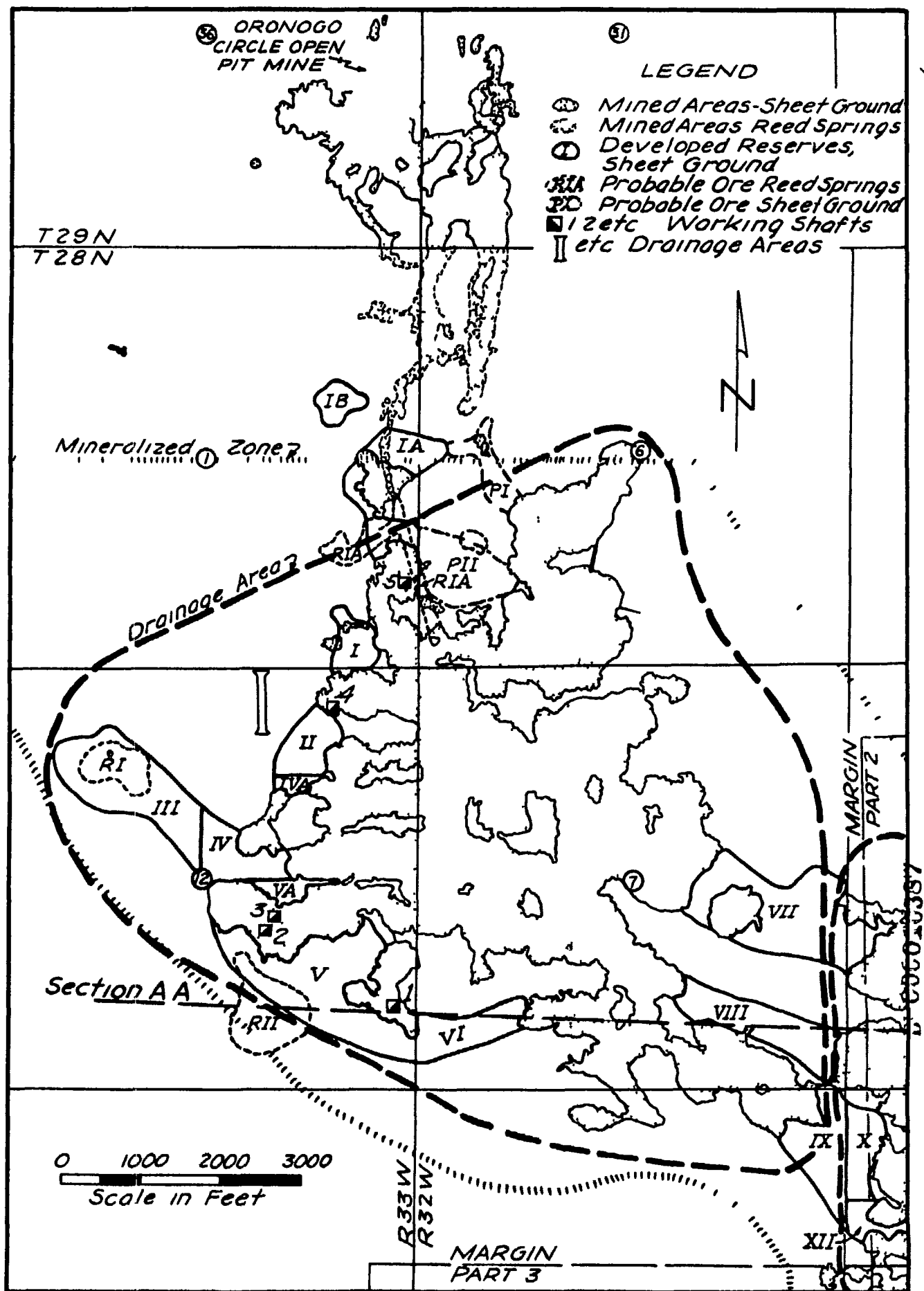
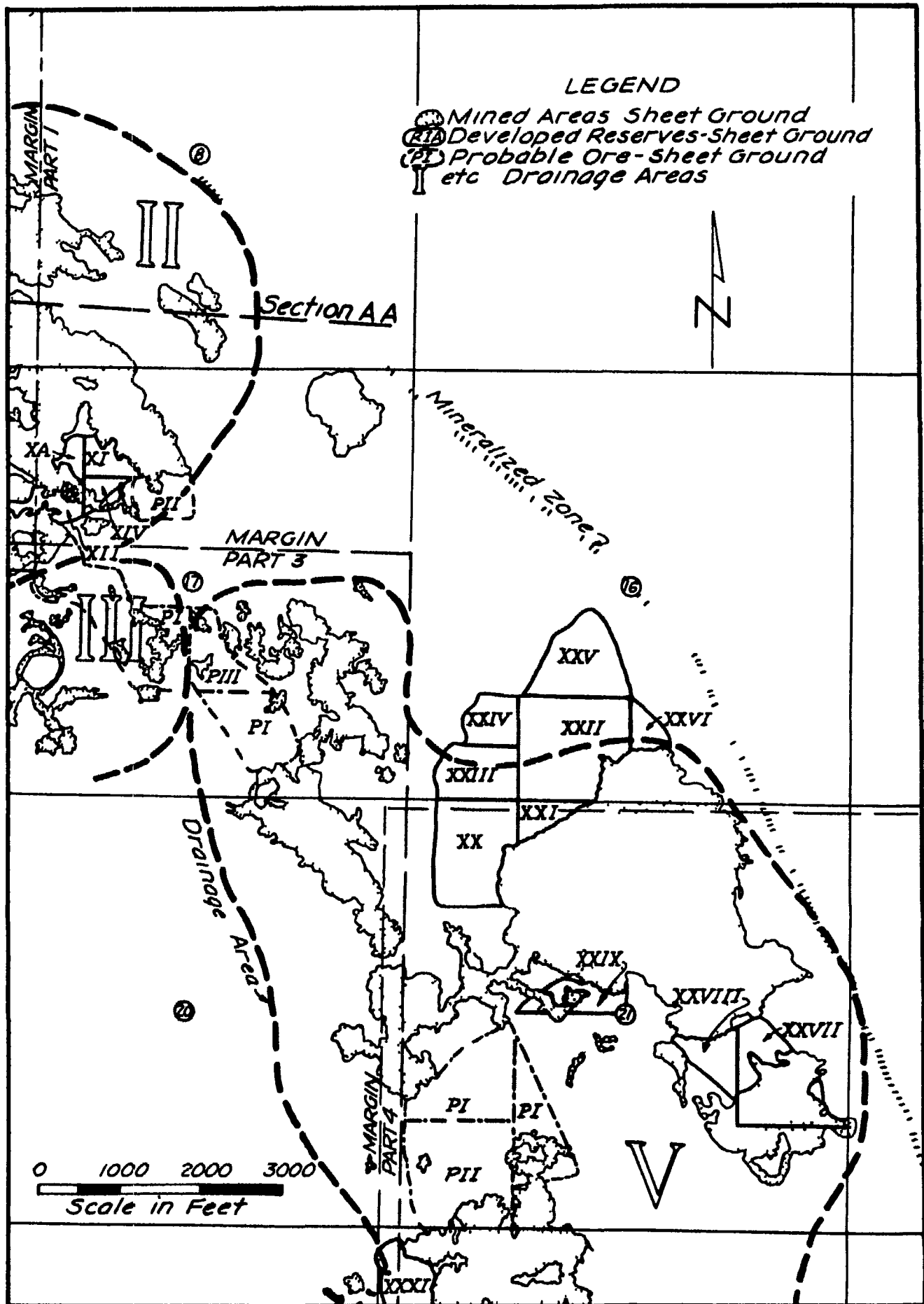
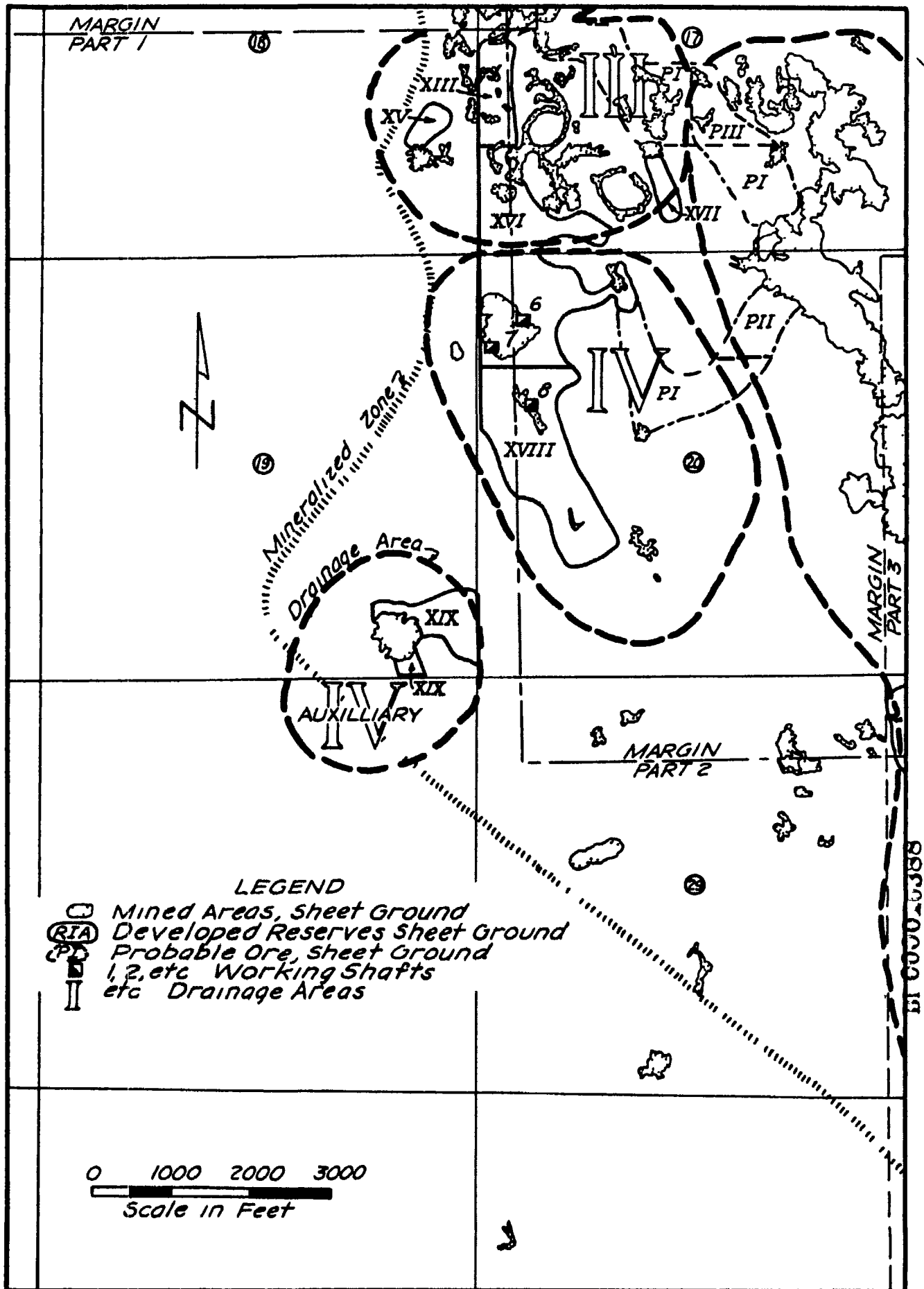


FIG-2- ORONOGO-WEBB CITY-DUENWEG DISTRICT
PART -1- MINED AREAS & RESERVES



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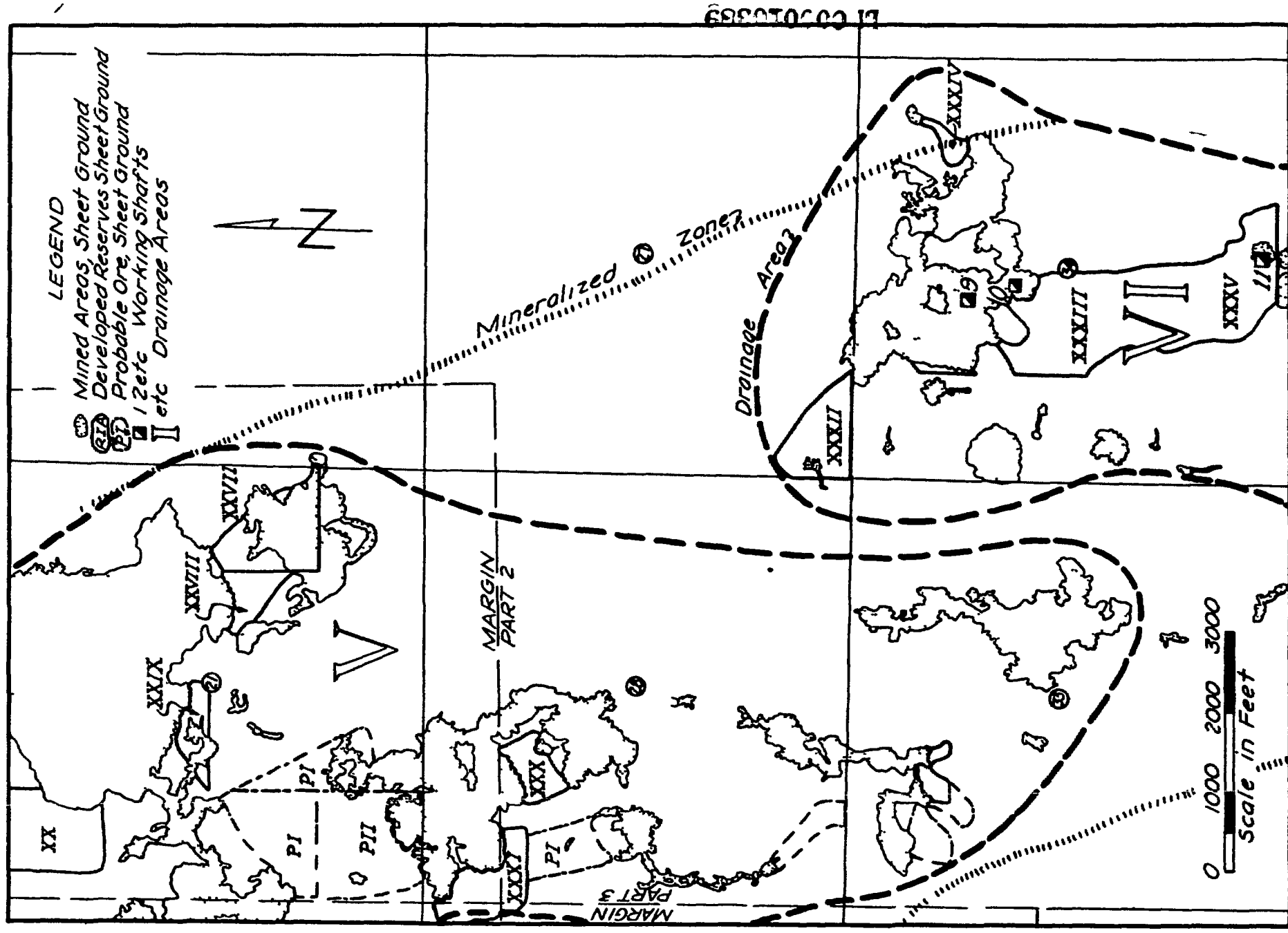


FIG-5-ORONOGO-WEBB CITY- DUENWEG DISTRICT
PART-4-MINED AREAS & RESERVES

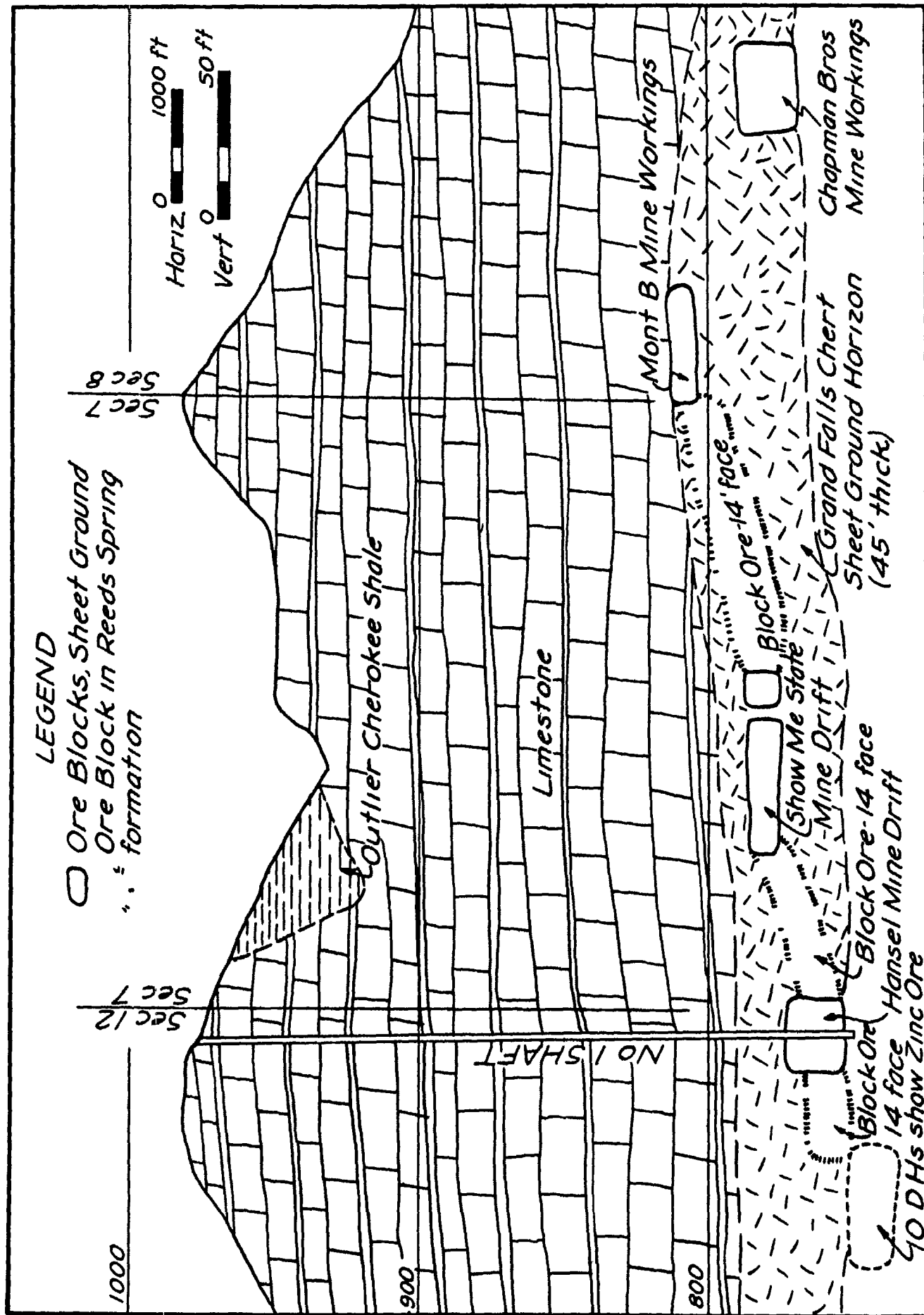


FIG-6-SECTION A-A

ESTIMATED RECOVERY OF CONCENTRATES

The average estimated combined unit recovery of concentrates from the proposed exploitation of the Webb City district is 28 percent. This estimate is considered conservative in view of the following analyses of available records:

1 Reference is made to the production records from 1909 to 1919 inclusive, given in Table 1.

During that period the average efficiency of concentrating plants was not over 65 percent. Weights of concentrates are in dry tons while the weights of ore were obtained from the number of "cans" hoisted, for safety reasons "cans" were never entirely filled. Hence to provide comparable conditions a 10 percent overweight factor is considered conservative. On this basis alone the sphalerite recovery would have been 2.04 percent and the combined recovery 2.42 percent. In modern mills operating at 85 percent efficiency the recovery of concentrates would have been 3.05 percent.

2 In addition to past production records, approximately 1000 drill hole records were examined. The results of the studies indicate that in the northern part of the district the sheet ground deposits have an average thickness of 14 feet with a recoverable combined mineral content of 3.57 percent.

3 In drainage areas II and III the average of 40 drill holes was 13 feet, with a mineral content of 3.16 percent.

4 In the mined areas of the American Davey mines 29 drill hole logs were analyzed. These showed a 12.8-foot face with a combined mineral content of 1.43 percent compared with the actual recovery of 3.04 percent.

5 In addition to the study of the drilling and production in the sheet ground horizon, a similar study was made of the Rees Spring horizon in the north end of the area. The drilling indicated a face of 10 feet with a mineral content of 4.5 percent. The actual mining was nearer a 12-foot face with an actual recovery of 8.31 percent.

6 During certain months of 1937, 1939 and 1940 approximately 49,000 tons of ore were mined from the north end of the sheet ground area and milled over a modern concentrator. The mining covered an average 9-foot face and three tracts were tested. The zinc concentrate averaged 60 percent zinc and the lead concentrate about 75 percent lead. The combined recovery of concentrates was 4.61 percent.

On the basis of a minimum recovery of 2.8 percent concentrates, and assuming a ratio of 7 to 1 of the zinc and lead concentrates, the estimated recoverable concentrates and metals from the available reserves are as follows:

Ore - Short Tons - 18,863,530

	<u>Zinc</u>	<u>Lead</u>	<u>Total</u>
Concentrates - percentage recovery	2.45	0.35	2.80
Concentrates - short tons	462,157	66,022	528,179
Metal in concentrates - percent	60	79	62.3+
Metal in concentrates - short tons	277,294	52,157	329,451
Percentage recovery of metal in concentrates	1.469	0.276	1.745

EXPLOITATION OF AVAILABLE RESERVES

Brown and Root, Inc. proposes to undertake: The drainage problem, the rehabilitation of a sufficient number of mines to produce 10,000 tons daily, the construction of a concentrating plant of this capacity, and the construction of necessary surface haulage.

The factors considered in the exploitation of the district are:

1. PUMPING - Except for the immediate north end of the area, all mine workings are under water. The pumping of the Eagle-Picher Mining Co. in the Oronogo Camp is holding down the water in that part of the district to 130 feet below the lowlands along Center Creek. In the extreme south end of the area at Duenweg, the Federal Mining and Smelting Co. is constructing a concentrating plant and plans to pump out a local area for early mining operations.

From the record of pumping operations by the Eagle-Picher Co. in 1937-1939, a detailed study of the district's pumping problems was made. The district has been divided into drainage areas, and shafts have been selected for sump stations. This study also provided a basis for locating power distribution points. The areas are numbered I to VI (See Figures 1, 2, 3, 4, and 5). Some repairs to old drainage ditches are required and it will be necessary to divert one drainage ditch around a caved area northeast of Webb City. Present plans call for installation of 17 nine-inch discharge turbine pumps with a total capacity of 26,000 GPM. These are directly connected motor-driven pumps designed to pump against heads of from 180 to 220 feet.

2. MINING - In order to provide hoisting capacity of 10,000 tons a day, 12 shafts will be repaired and equipped with hoists, derricks and storage hoppers. These have been selected adjacent to the larger developed ore areas. (See Figures 2, 3, 4, and 5). Plans call for two shift operation, or a possible production of 12,000 tons daily. Underground facilities, such as 100-ton storage hoppers at shafts, ramps, workings, battery charging stations, will be installed for complete mechanized loading and hauling of ore.

In addition to air compressors and drills, mechanical ore loaders will be installed to take the place of hand snoveling and storage battery trucks used for underground haulage

3 SURFACE HAULAGE - Some road construction will be required to deliver ore to railway haulage centers. Contracts with the railroad provide for rail transportation of most of the ore to the central mill

4 MILLING - Plans for a central concentrating plant consisting of a weighing and sampling unit, heavy media separation, gravity concentration and flotation, with a capacity of 10,000 tons in three 8-hour shifts, are proposed. A list of the required equipment exclusive of that required for coarse crushing and heavy media separation is given below. See Figure 7 for the flowsheet

- 1 Conveyor from cone mill - 24" wide
- 2 2 bucket elevators - 24"
- 3 2 screens - 5 x 10-7/16"
- 4 60 x 24" rolls - 1 set
- 5 42 x 48" 6-cell jigs - 6 required
- 6 Dewatering cones - 6 required
- 7 Smitten elevator - 24", 1 required
- 8 Esperanza classifier - 24" wide, 1 required
- 9 36 x 42" cleaner jig, 2 required
- 10 Chat elevator - 24", 1 required
- 11 Chat screens - 48", 2 required
- 12 Chat rolls - 60 x 24", 1 set required
- 13 Chat dewaterer - 24" - 20"
- 14 4-cell St Joe classifier
- 15 Chat concentrating tables, 8 required
- 16 Table tailing elevator - 24"
17. Tailing dewaterer screen - 4' 24" - 28'
- 18 Tailing sample cutter
19. Tailing conveyor
- 20 Table middling elevator - 24"
- 21 Middling screen - 4 x 10
- 22 Middling drag - 24 - 20, 1 required
- 23 St Joe classifier, 1 required
- 24 Coarse tables, 8 required
- 25 Master Esperanza classifier
- 26 Sand elevator - 24"
- 27 Sand screen - 5 x 10, 1 required
- 28 Sand drag
- 29 Ball mill
- 29-A. Ball mill
- 30 Sand classifier
- 31 Fine sand tables
- 32 Lead middling table, 1 required
- 33 Lead middling pump
- 34 Zinc middling table
35. Zinc middling pump

BU COC010393

- 36 Dorr Thickener 3 - 65' 0" required
- 37 Diaphragm pump, 3 required
- 38 Wilfley pump, 3 required
- 39 Lead float cells, 8 required
- 40 Lead pump
- 41 Lead filter
- 42 Lead concentrate car
- 43 Zinc float cells, 14 required
- 44 Float sample cutter
- 45 Wilfley tailing pump
46. Zinc concentrate pump - Wilfley
47. Zinc filters
- 48 Zinc float concentrate - conveyor
- 49 Zinc float conveyor
- 50 Table concentrate dewaterer
- 51 Coarse concentrate conveyor

5 POWER - From the power lines of the Empire District Electric Company will come the power for all departments of the operations. Approximately 15 miles of pole-line will be necessary to reach the different pump and shaft stations and central mill.

ESTIMATED CAPITAL REQUIREMENTS

The total estimated capital requirements are \$2,387,953, distributed as follows:

1	Pumping equipment and initial drainage	\$ 155,000
2	Surface equipment for mining	285,800
3	Underground mining equipment	575,686
4	Preliminary mine development	90,000
5	Surface haulage construction	40,000
6	Concentrating plant	941,467
7	Working capital	<u>300,000</u>
	Total	\$2,387,953

The details on the above distribution are:

1 Pumping Equipment

17- 9-inch turbine pumps, direct motor driven with all fittings, pipe, etc - 26,000 GPM delivered	\$ 62,682
Installation, including shaft repairs	17,000
Surface drainage ditch repairs	<u>22,500</u>
	102,182
Pumping power and labor for six months	<u>52,818</u>
Total pumping cost	\$ 155,000

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FIG-7-FLOW SHEET-WEBB CITY CENTRAL MILL

2. Surface Equipment for Mining.

12 hoists at \$2,000	\$ 24,000
12 hoppers and derricks at \$6,000	72,000
Electrical equipment	100,000
Ten 3/4-ton pick-up trucks	9,000
Two 3-1/2-ton trucks with winch	4,600
Two 5-ton trucks with winch	6,200
12 change houses at \$2,500	30,000
1 complete blacksmith shop and machine shop	25,000
1 bit and steel shop	6,000
1 electrical shop	6,000
Miscellaneous equipment	<u>3,000</u>
	\$285, 800

3 Equipment for Underground Mining:

105 D-505-4-30" crank-air drills at \$620	\$ 65,550
105 machine accessories, hose fittings, posts, tripods, etc	27,806
30 tons drill steel at 13 5 cents	8,100
25 48" drag ramp electric loaders	100,000
25 utility hoists (tuggers) for above	49,300
39 electric trucks	117,000
26 steel trailers	78,000
60 1450-pound cans at \$24	1,440
12 miscellaneous each shaft at \$350	4,200
10 jack-hammers at \$180	1,800
30 type 40-75 M H portable com- pressors, dual control at \$2,880	86,400
10 type 40-90 M portable compressors, dual control at \$3,429	34,290
10 air receivers at \$180	<u>1,800</u>
	\$ 575,686

4 Preliminary Mine Development

Cleaning up around bottom operating shafts, etc	\$ 6,000
Underground ramps, hoppers, rails, etc.	20,000
Construction of battery charging stations	14,000
Preparing underground haulage ways and testing mine faces	<u>50,000</u>
	\$ 90,000

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5 Surface Haulage Construction:

Road construction and repairs to existing roads	\$ 3,000
Loading ramp in north end of area	17,000
Construction of railroad spurs, turn-outs and load sidings	<u>20,000</u>
Total	\$ 40,000

6. Concentrating Plant

Cleaning and grading plant site	1,000
Construction pond and slime pond	5,000
Sinking deep well, pump and tank	10,000
Excavation of primary storage hopper (5,410 cubic yards)	5,000
Construction of 6-reinforced concrete storage hoppers, 500 tons capacity each	48,400
Excavation of secondary storage hoppers	4,000
Construction of re-inforced concrete hoppers	22,000
Material, machinery and installation cost of heavy media plant as proposed contract of American Cyanamid Co.	100,000
Material, construction cost of three 75-foot Door thickeners	30,000
Mill equipment, motors, machinery, etc	386,067
Material for mill buildings, erection cost and installation of machinery cost	<u>330,000</u>
Total	941,467

7. Working Capital Requirements:

Deposit on electrical transmission lines, transformers, which is returned at 10 percent on monthly current consumption	175,000
Two months working capital (labor, supplies and power)	110,000
Exploration fund over period of one year (lease obligation)	<u>15,000</u>
Total	\$ 300,000

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PROPOSED EXPLORATION BY THE BUREAU OF MINES

In addition to the estimated ore reserves, there is evidence that an additional 16,000,000 tons may be developed through exploration by churn drilling.

Approximately 1,000 drill logs are now available, most of which can be definitely located in the field. Preliminary studies have been made of groups of holes in exploited areas to ascertain how close the indicated values in the holes checked with actual ore extraction, but there is still much to learn of unexploited reserves in roofs and floors over large areas. The study of this group of drill logs also indicates that the Reed Springs formation has been neglected as a promising source of new ore reserves in the Webb City district. The levels discovered in the Reeds Springs formation by drilling and subsequently worked by the Oronogo Mutual and D. C. and E. Companies indicate orebodies of the "long run" type from 100 to 200 feet wide and from 8 to 13 feet thick which show combined concentrate recoveries of from 6 to 11 percent, and such orebodies cannot be passed over as unimportant at this time. So far, the evidence points to the location of such orebodies along zones of fracturing and beneath well mineralized orebodies in the upper horizons. Planned drilling with relation to fracture zones and known horizons of rich ore in the upper horizons offers possibilities of giving the district not only additional reserves and longer life but ores with a higher content of zinc and lead than in the sheet ground reserves.

In addition to the above program there are numerous areas that have been classed as probable blocks of "sheet ground" where additional drilling is required to bring it into the developed class. There are hundreds of acres in the mineralized belt that have never been drilled.

The Bureau of Mines proposes to undertake an exploratory program planned in relation to known factors of previous drilling, mine workings and the local geological features for at least 50,000 feet of churn drilling. The estimated cost of this initial program, based on employing 10 drills and completing the project in one year is \$100,000, distributed as follows:

Engineering and Clerical:		
1 Project engineer	\$3,800	
1 Surveyor - draftsman	2,400	
1 Clerk-stenographer	1,440	7,640
Labor (Samplers and others)		7,200
Traveling expenses		2,500
Supplies and equipment		2,500
Freight and express		750
Churn drilling - 50,000 ft. at \$1.50		75,000
Reserve for contingencies		4,400
Total		100,000

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SCHEDULE OF OPERATIONS

Initial work on this project is the installation of power units and pumps. A three-month period is sufficient to install all 17 pumps. A six-month period is allowed for complete dewatering of the district but certain areas will be available for mining operations within four months after pumping is started. Construction of the concentrating plant should be started immediately, and it is estimated that the mill could be completed in nine months. All other work and installation of machinery in mines can be completed during the construction period of the mill. By starting on March 1, production of new zinc and lead should start on January 1, 1944.

PRODUCTION RATE

The proposed rate of production is 10,000 tons daily for 350 days during the year, giving a total of 3,500,000 tons over a period of 5.389 years starting January 1, 1944. The yearly production of metals is estimated at 51,455 tons of zinc in 85,759 tons of 60 percent zinc concentrate and 9,678 tons of lead in 12,251 tons of 79 percent lead concentrate.

ESTIMATED COSTS OF OPERATIONS

On the foregoing production basis, the estimated cost of operations, exclusive of royalty, but inclusive of amortization charges without interest on the initial investment, is \$1.93 a ton, distributed as follows:

		Cost a Ton
Pumping		\$0.03
Mining		1.00
	Ore breaking	0.70
	Machine loading	0.15
	Mine haulage	0.06
	Hoisting	0.09
Surface haulage		0.21
Concentrating		0.41
	Screening	0.04
	Milling	0.37
Exploration		0.02
Insurance		0.05
Overhead and reserve for contingencies		0.08
Amortization of \$2,387,953 on 18,863,530 tons of ore (Without interest)		0.13
	TOTAL... ..	\$1.93

With a ratio of concentration of 35.7 to 1, the operating cost per ton of combined concentrates is \$68.09 a ton.

CONCLUSIONS

Based on the evidence obtained from field research, the accumulated experience of engineers, mine operators, and superintendents, and the records of production and recoveries, the Bureau of Mines concludes that:

1. There are available reserves of 18,863,530 tons of ore from which modern mills operating at 80 to 85 percent efficiency can recover 1.469 percent zinc a ton in 60 percent zinc concentrate and 0.276 percent lead a ton in 79 percent lead concentrate.

2. The developments of 146 former operating companies have opened sufficient shafts and 38.4 miles of mine faces so that 10,000 tons of ore may be mined daily over a period of 5.389 years

3. The anticipated yearly production of new zinc and lead based on smelting efficiencies of 90 percent and 98 percent respectively, for zinc and lead is 46,311 tons of zinc and 9,484 tons of lead, starting early in 1944

4. In view of the requirements for new zinc and the rapid depletion of other reserves in the Tri-State district, the exploitation of the sheet ground deposits in the Webb City district is essential and all possible assistance should be given to the sponsors of this project.

Coincident with the drainage of the district, the Bureau of Mines plans to explore certain areas with the aim of developing higher grade ores for immediate production.

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6. Joplin Folio, U S. Geological Survey, No. 148
7. Topographic Sheets, U. S Geological Survey, Joplin Quadrangle.
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BROWN & ROOT INC
HOUSTON TEXAS

February 22, 1943.

Mr. A. E. Kipps
War Production Board, Zinc Branch
Temporary B, Room-1814
Washington, D. C.

Dear Mr. Kipps:

Confirming your request for a percentage breakdown of Critical Material required on the Zinc Plant for the Webb City Area, we find that 35.3% of dollar value comes in this category.

We have submitted our list of Equipment to the Priority Division of the War Production Board and they feel we have cut our figures to the limit and the Final sub-division of Critical Material is as follows:

Pumps.....	\$ 13,800
Underground.....	\$13,029
Surface.....	54,800
Mill.....	164,525
Transmission Lines.....	<u>50,000</u>

\$ 495,365

The above represents 35.3% of our Total Estimate of the Project.

We feel that this is the figure you were desirous of obtaining.

Yours very truly,

BROWN & ROOT, INC.

By: _____
D'Arcy Cashin, Agent.

6-16-43
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